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DESIGNATION OF FLOOD PLAINS IN BAVARIA (GERMANY)

Discussion paper transmitted by the Government of Germany */

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1. Problem definition

There has always been an enormous pressure on settlement planning in natural flood plains. With extreme flood events, this development means a growing hazard for the population, accompanied by an increasing danger potential.

To avoid an increase in risk, and if possible, to reduce risk, it is the objective of water management and regional planning to intensify the efforts for preventive flood protection, and to provide retention areas as a basis for flood risk management.

Preventive planning is necessary to improve the possibilities to keep settlements out of endangered areas according to the principles of sustainable regional planning.

Retention areas and flood plains, lost in the past by different activities, should be recovered. Therefore, a very specific knowledge of flood plains is required.

2. Objectives for the designation of flood plains

A prerequisite for the protection of flood plains against other competing uses is created by the designation of flood plains. The representation of priority areas and reserved areas in regional plans and the determination of flood plains by legal determination in accordance with the water laws should be used increasingly for preventive flood protection but also for the safeguarding and development of free spaces and their ecological functions.

- recording of flood plains for the total area of Bavaria
- designation and determination of flood plains according to the requirements of regional planning and the determination by legal regulations
- development of digital maps for a growing planning security for regional planning, river basin planning and municipal planning
- detailed information of the public about existing flood plains
- integration of flood plains into the „Information system natural alpine hazards“

Accordingly, these objectives meet the requirements for preventive flood protection, sustainable spatial development and an increased planning security.

3. Importance of this project

In a special way this project takes into account the requirements of regional planning as well as those of water management by developing basic guidelines such as:

- conservation of still existing areas for flood retention and flood discharge

- avoidance of a growing potential of damages in areas susceptible to flooding, especially by keeping them clear from settlements
- it must be secured that existing flooding conditions are not being changed negatively neither for the upstream nor the downstream neighbour
- encouraging the natural retention potential of waters and flood plains
- gaining information on areas which can be (re)activated for improved flood retention
- secured regional planning, recovery and development of flood plains
- damage prevention by avoidance respectively reduction of uses with high potentials of damages in endangered areas
- designation of retention areas which can possibly be (re)activated, and which then can help to reduce high water risks
- increased awareness of risks with respect to the dangers flooding events can cause

4. Main operational steps

For the designation and determination of flood plains the following operational steps must be observed:

- investigation and documentation (flood risk areas, available basis for their investigation, need for action)
- gaining of a current and homogenous basis (especially digital information on altitude, location and utilisation; hydrological data)
- data processing (creation of digital maps and altitudinal models)
- determination of flood plain boundaries applying uniform methods)

5. Investigation and creation of basic data

For the delimitation of flood plains by means of hydro-technical calculation methods the following data must be made available or acquired:

- Basic hydrological data:
Peak runoff data of typical floods are normally gained by means of flood longitudinal profiles (= distribution of flood runoff of certain mean recurrence intervals in relation to the respective river kilometre) and flood diagrams (= double logarithmic distribution of the flood runoff of certain mean recurrence intervals in relation to the respective catchment areas)
- River equipment/river mapping:

Requirements:

- subdivision of the river into kilometres
- surveyed river section signs (and section reference points)
- terrestrial surveyed current channel cross sectional profiles

- Aerial photography and air survey:
Photographs taken from the air must provide stereoscopic pictures with at least a 60% longitudinal overlapping and a 30% lateral overlapping (under consideration of parallel flight corridors) For the delimitation of the area chosen for the aerial photography, the circumference of the flood plain is assessed according to maps on a scale 1: 25,000 or larger. Flights are carried out on a picture scale of 1:5000. This means that digital topographic models can be produced with a maximum altitudinal error in measurement of one decimetre.
- Site evaluation
For the imagery of flood plains, site plans on a 1:2,500 scale based on photogrammetric evaluation are drawn up showing the most important objects essential to water management
- Use-related mapping
Additionally to site evaluation, a basic catalogue of all kinds of utilisation is acquired by photogrammetry. In doing so, a documentation of a mosaic of current uses is obtained, which can also be used for assignments of roughness in hydraulic calculations as well as for basic information for river development planning.
- Preparing digital topographic models (DGM):
Digital topographic models (DGM) can be produced by interpretation of aerial photography and terrestrial supplementary measurements.
- Field comparison:
Objects and areas important to water management which could not be interpreted by photogrammetry can be identified on the ground by field comparison.
- Terrestrial survey:
Terrestrial surveys are a supplement to photogrammetric interpretation and must be applied if
 - special sections are needed (for constructions as for instance bridge sections, culverts, weirs etc.)
 - for some parts of the area, the photogrammetric interpretation of morphological structures which are important for flood runoff is impossible
 - field comparison has shown that supplementary measurement are necessary
- Current water level fixation(s):
For hydro-technical calculations current water level fixations sufficient for gauging purposes must be made available.

6. Data processing and data structure

6.1. Data processing

In cases where data were gained by photogrammetric interpretation of aerial photography and air surveys - if required, the necessary information can additionally be obtained by terrestrial investigation- the processing of location and utilisation data is standardised by using GIS-systems Arc View. The data can therefore be used in the framework of the Arc/INFO based GIS "Water Management" at the Bavarian Water Management Agency, but also at all Arc View work stations which are installed at all Bavarian State Offices for Water Management.

6.2 Data structure

The basic idea for the development of the data structure is the integrated availability of all project -related data in digital form and their processing in a standardised data processing work environment. Data are filed with respect to the relevant waters and comprise the following main data blocks: GIS-data, CAD-data, DGM-data, plots and ArcView work aids.

The GIS data consist of the following data blocks: project describing data, cartography, waters, altitudinal data, objects related to water management, developments, traffic/supply and utilisation

7. Data documentation

7.1 Digital topographic models

The calculation of flood plain areas for the determination by legal regulations is based on qualified descriptions of the terrain. Precise digital topographic models (DGM) must be prepared for flood risk areas in decimetre-accuracy.

The application of DGM mainly comprises

- determination of detailed contour lines
- Calculation of valley cross sections and linkage with channel profiles to total cross sections
- determination of calculation networks for hydraulic-numeric 2d-models
- determination of flood plain boundary lines based on profile-related calculations or hydraulic calculations which are related to a calculation network
- production of ortho-photographs

7.2 Digital Maps

Within the respective flood plain area, project-related objects and uses are represented in maps (scale 1:2,500) as a result of the processed data.

Interpretation and assessment concern in detail the following object groups: waters, vegetation, development, traffic, supply, woodland, woody plants, water management, operational areas, agricultural areas, altitudinal information (contour lines, topographic peaks) and other related objects and land uses.

8. Hydro-technical calculations

In cases where boundary lines cannot be drawn on the basis of existing data of typical current flood events, flood plains must be determined by hydraulic calculation methods. Typical floods, determined by hydrological methods (as a rule floods of hundred years' frequency = HQ_{100}) and if necessary further decisive floods (e.g. HQ_5 a flood event of a 5 years' frequency, causing soil erosion) are the basis for these calculations. Additionally, documents about flood events of minor significance should be used as supplementary information for the delimitation process.

Hydraulic calculations are normally carried out by WSPWIN, a programme for the calculation of different water levels (1-d calculation). For more complex calculations also hydraulic-numeric 2-d models can be applied. This may be the case for

- strongly developed or significant transverse or return currents
- retention areas which must be registered in detail
- branching currents and /or merging currents within the flood run off or
- substantial non-horizontal water levels

9. Summary

The most effective way to avoid risks for the population as well as flood damages is the prevention of danger potentials in areas which are susceptible to flooding. By intensifying the efforts to achieve a preventive flood protection, especially by providing special-use corridors as a fundamental component for flood risk management, an important contribution to sustainable regional development can be achieved.

To secure these special use corridors for flood retention and high water discharge against other uses, the designation of flood plains is settled in the Water Resources Law (WHG). In order to fulfil this legal obligation, Bavaria started in June 1996 the project "determination and designation of flood plains in Bavaria" within the scope of a nation-wide initiative. The water management administration is responsible for determination of flood plain boundaries, whereas the designation of flood plains by legal regulation lies within the sphere of responsibility of the district administration authorities.

First priority for the designation of flood plains have all major waters in Bavaria, i.e., water class I and II with a total length of about 9,000 km and additionally smaller water class III within housing areas or infrastructure facilities. So far, one third of the required designations along these waters have been put in practice. Consequently, it is an urgent objective of this project to determine flood plains along side waters of an approx. length of

6,000 km and prepare them for legally based designation. It is planned to achieve this by the end of the year 2005. Afterwards it is intended to determine flood plains within restorable retention areas, alongside smaller rivers.